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Research and Developing on Intelligent Mobile Robot Remote Monitoring and Control System

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Abstract

In this paper, combining intelligent mobile robot with wireless remote control technology, wireless network communication platform between mobile robot and computer is set up. By the platform, the function of wireless transmission data is achieved, and wok state of mobile robot is remote monitored and controlled. Accordingly, operator and robot run in line and complete heavy task in complex environment.

Keywords: Intelligent mobile robot; Remote monitoring and control; Wireless communication;

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1. Introduction

For years, wireless communication technology makes us get rid of bondage of wire cable. We can see network resource or achieve combine between wireless equipments in anyplace and anytime. In engineering, intelligent mobile robot needs keep popping in and out in all kinds of sites freely. But traditional wire communication mode makes robot be limited by wire cable, and the mobile capability is low. However, if data is collected and monitored and controlled by wireless communication, it will not be limited by cable, the operating will be convenient and the anti-jamming capability will be enhanced. Therefore, intelligent mobile robot based on wireless communication mode is superior in practical engineering.

2. Constructing of intelligent mobile robot remote monitoring and control system

2.1. Controller choice

Motion control is performing unit, and its capability touches the motion reliability and stability of mobile robot directly. Therefore, the accurate and high efficiency motion controller is very important for the whole capability of mobile robot. PMAC is one of the best functions multi-axes motion controllers in the world at present. It not only has very high reliability but also has very high stability and real time, and can complete many kinds of complicated control. Accordingly, it has been used widely in all kinds of numerical control machine tools and robot control system. In this paper, in order to enhance robot motion precision, PMAC2-PC104 controller is adopted. The same as other PMAC, PMAC2-PC104 is a high-powered and programmable multi-axes controller, and can be controlled by setting different parameter and flexible programming. It communicates with upper layer PC by serial communication interface RS232. In addition, DelTa Tau corporation provides choice accessory for it, such as 32 I/O interfaces, 32 fixed input interfaces, 8 fixed output interfaces and 4 analog input interfaces. By the interfaces, the signals come from all kinds of sensors are accepted and outer units are controlled.

2.2. Constructing of remote motoring and control system

In this paper, the robot remote motoring and control system composes of upper layer PC, wireless network and under layer PC. It is shown in Fig.1. The upper layer PC is common engineering control computer. Wireless network adopts wireless serial interface server WDS203. Under layer PC is intelligent mobile robot developed in laboratory by ourselves. Because RS232 in PMAC serial interface defining accords with WDS203, they are connected only by wires.

In the design, PC/104 mainboard communicates with outer units by parallel interfaces. However, in order to reduce cost in remote wireless communication, serial communication mode is adopted between upper layer PC and mobile robot. The serial communication is that outer units and PC transmit data by one data wire and a bit data takes up a fixed time.

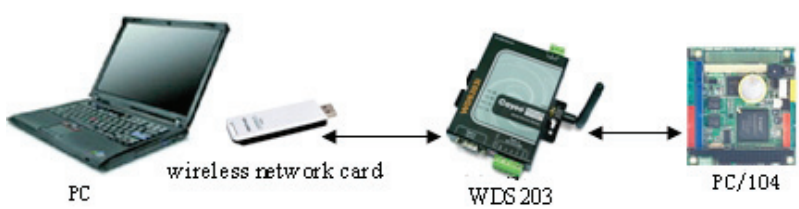

Fig.1. Constructing of wireless communications network

In hardware constructing of serial communication, PC/104 SBC (Single Board Computer) is adopted. The SBC has 4 absolute serial interfaces and may satisfy multi-serial interfaces communication demands. Remote computer communicates with the SBC by WDS203 serial server and Ethernet. In upper layer PC, WDS203 serial interface is mapped into dummy serial interface by COM-Redirector software, and intrinsic Windows application has the function of remote monitoring by network. The web server in WDS203 is used to collocate and diagnose and monitor the linked equipments. Based on the tasks and the run surroundings and the demands of remote wireless control for the mobile robot, IBSS structure is adopted in wireless communication network and the control of intelligent mobile robot is achieved.

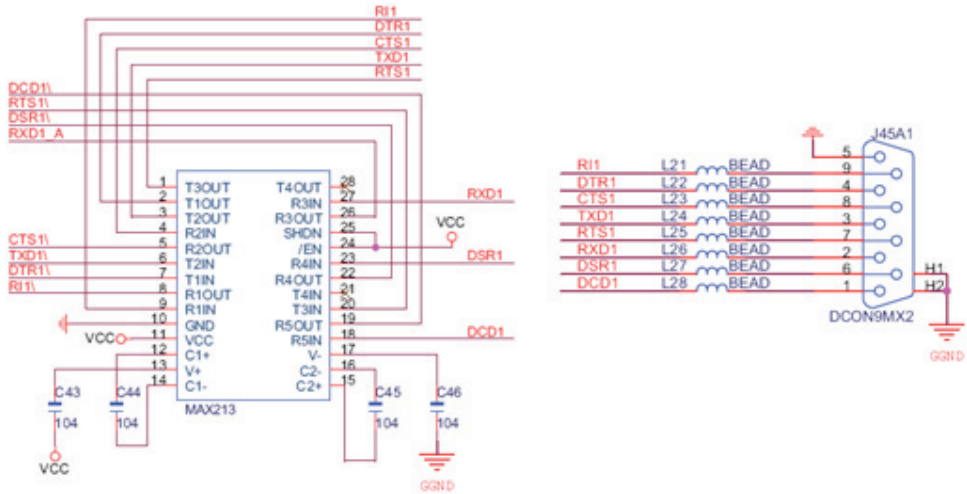

Fig.2. Interface circuit of serial communication

In the wireless communication system design, wireless serial interface server has transfer and link functions. At present, usual serial port has 9 pins (DB9), and its interface circuit is shown in Fig.2. and its pin functions are shown in Table.1.

Table 1. Styles account of DB9 pins

Pin	Symbol	Function	Pin	Symbol	Function
1	DCD	data carrier detect	6	DSR	data unit ready
2	RXD	receive data	7	RTS	request transmit
3	TXD	transmit data	8	CTS	concent transmit
4	DTR	data terminal ready	9	RI	bell indication
6	GND	grund			

In engineering, the simplest and the most usual connecting means is three-wire means, namely ground, RXD and TXD three pins. The both sides may RXD and TXD. When the mobile robot is in initialization or debugs the system, all kinds of parameters need be set. In order to know the running state of the robot and control it in real time, the intelligent mobile robot must be abundant in interfaces. Considering its mobile characteristic, the controller does not connect general interface units such as display screen equipment, keyboard, and so on. But enough data communication interfaces are provided such as RS232, parallel interfaces, and otherwise. By the interfaces, real time data can be uploaded into PC and the running state can be shown in real time, and the parameters and control instructions can be transmitted to the intelligent robot by the upper layer PC and the function of system setting and control in real time are achieved.

2.3. Wireless communication criterion choice

Combining characteristic of the object, 802.11b criterion wireless communication technology is used in intelligent mobile robot remote monitoring and control system. Its transmitting speed can reach to 11Mbps and is very high. When signal is feeble and is jammed, its bandwidth may adjust to 5.5Mbps、2Mbps and1Mbps automatically. Thus, network stability and reliability are ensured effectively. In addition, its effective space is long and can reach to 100-300m. 802.11 wireless network has good tolerating capacity. As long as AP is fit on the primary network, wireless network servings will be provided, and if wireless network card is fit on the terminal unit, all network resource will be seen, which is nearly the same as used wire local area network.

2.4. Choices of control mode of mobile robot monitoring and control system

Commonly, remote robot control modes comprise serial instruction control, scatter instruction control, monitoring control, and so on. Serial instruction control is traditional control mode. Its precision is high, but sampling must be needed, and controller can act after the control instructions come from upper layer PC must be received. Thus, control efficiency is reduced and is not fit for remote control system. Scatter control reduces control efficiency but is fit for improving network transmitting capability, however, control capability for system is affected. Monitoring control adopts remote independence control modes, and the operator of upper layer PC monitors the remote robot work state and may manipulate the robot work. Therefore, the remote robot must have some independence capacity. In the work, remote robot runs independently according to the signals come from peripheral units. These modes is higher and higher in control level, and operator controls robot more and more easily. However, in order to ensure the capability, the intelligent level of remote robot must be improved. In this paper, the intelligent mobile robot has some independent capacity, and monitoring control mode is adopted to set up the whole remote monitoring and control system.

2.5. PC/104 serial interface communications program design

In this paper, PC/104 (under layer PC) is DOS system, but upper layer PC is Windows system. Therefore, mainly aiming at the two platforms, the design achieves serial communication by dint of wireless serial interface units. Software design adopts C language, and run environment is DOS 7.0. Thus, the program has good readability and can transplant other platform easily. There are many kinds of serial interface communication methods in the DOS system. Combining the practice circumstance, directly read-write UART interior register method is adopted. By in-out functions provided by C language such as inportb(), outportb(), the asynchronous serial communication of PC104 module is realized. PC/104 serial interface communication program flow chart is shown in Fig.3.

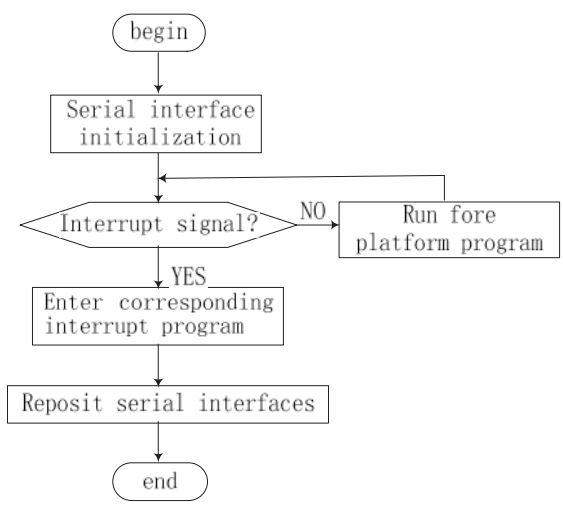

Fig.3. Serial interface program flow chart

3. Software whole design

In order to make system have maneuverability, convenient servicing characteristic and can be expanded, modularization design method is adopted in system developing. According to system function, different function modules are designed. It is shown in Fig.4.

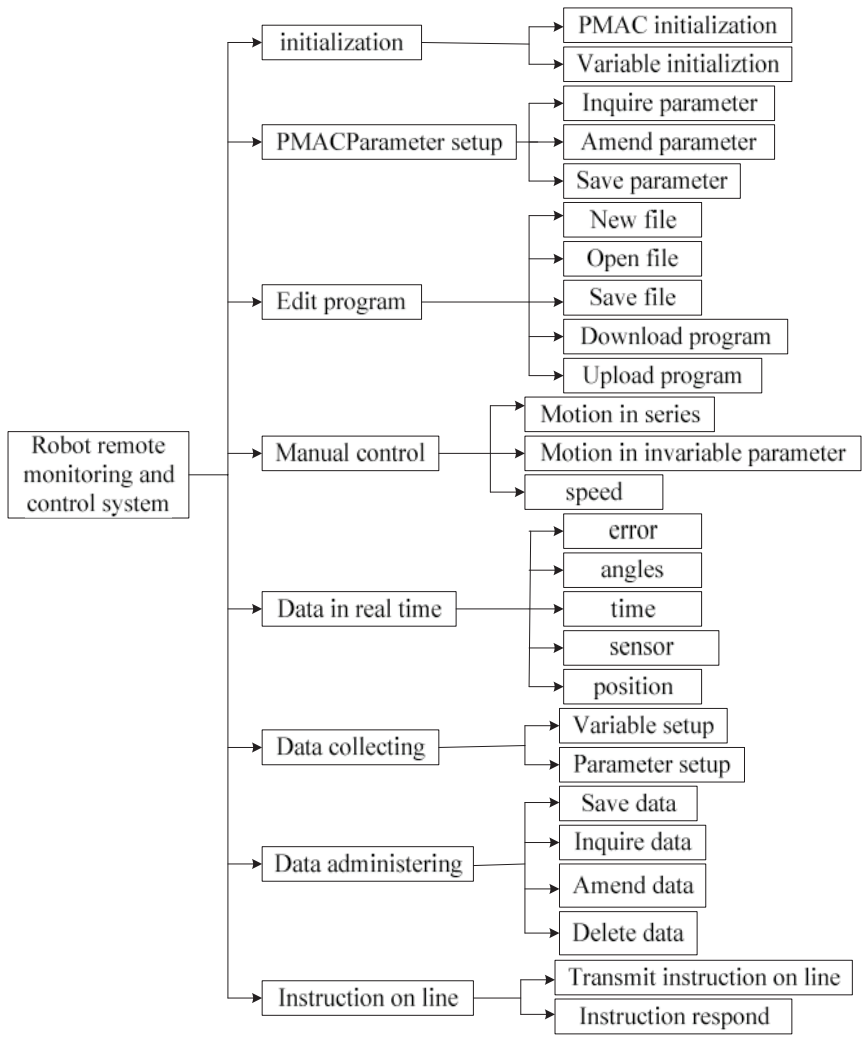

Fig.4. Software structure of the monitoring and control system

4. Conclusion

In this paper, remote control technology based on wireless communication is applied in remote control system of intelligent mobile robot successfully. An intelligent robot remote monitoring and control system based on wireless local area network communication is designed. The experiments show that the system can receive the speed signal, position signal and other state signals of the robot in real time and well and truly. All function modules can run normally, and the function of remote monitoring and controlling of intelligent mobile robot is realized, and anticipative purpose is attained.

Acknowledgements

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References

[1] Sobh T, Sanyal R, Wang B，Source．*Remote surveillance via wireless-controled mobile robots[J].* Proceeding of The World Automation Congress, 2004, p.t15：541-546.

[2] Douglas E.Comer. *Internet working with TCP/IP Voll Principles, Protocol，And Architectures[D].* Beijing：Publishing House Of Electronics Industry. 2005.

[3] Stefam Waldhett, Roseli Romero and Sebastian Thrun. *A Gesture Based Interface for Human-Robot Interaction.Autonmous Robots[J].*2000,（9）: 151-173.

[4] Baoquan Zhao. *Research on key technology of mobile robot in network control[D].* Tianjin: Tianjun University of Technology, 2006:31-33(in Chinese).